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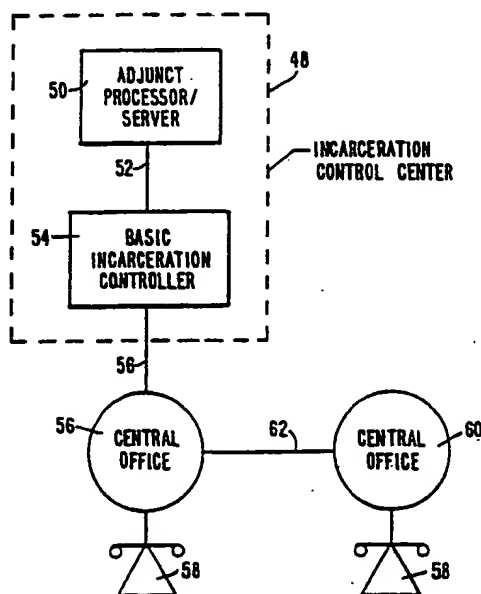
A method and system is disclosed for remotely verifying attendance of a particular person at a predetermined confined area. Monitoring and verification is performed through a telephone network including a telephone on the premises of the location of confinement and a control center. Voice verification, using voice analysis of speech transmitted in a telephone call from the site to the center is performed during periodic testing. A voice template vocabulary is established for the individual and used for voice verification. Caller line identification of each incoming call is performed to verify that call originates from the appropriate location. The confined individual is required, either randomly or at scheduled intervals, by the system to call the control center and recite a statement including randomly selected words from the template vocabulary.

1. The first step is to identify the problem. This involves understanding the current situation and what needs to be changed.

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(54) Title: METHOD AND SYSTEM FOR HOME INCARCERATION



(57) Abstract

A method and system is disclosed for remotely verifying attendance of a particular person at a predetermined confined area. Monitoring and verification is performed through a telephone network including a telephone (58) on the premises of the location of confinement and a control center (48). Voice verification, using voice analysis of speech transmitted in a telephone call from the site (58) to the center (48) is performed during periodic testing. A voice template vocabulary is established for the individual and used for voice verification. Caller line identification of each incoming call is performed to verify that call originates from the appropriate location. The confined individual is required, either randomly or at scheduled intervals, by the system to call the control center (48) and recite a statement including randomly selected words from the template vocabulary.

METHOD AND SYSTEM FOR HOME INCARCERATIONTechnical Field

5 The present invention relates to remote verification of the presence of a particular individual within a predetermined confinement area, broadly described as a home incarceration system. More particularly, the invention is directed to a method and system for remotely confirming that the individual is at the prescribed premises by communicating with the individual via a telephone network, identifying the location by utilizing caller line identification and identifying the individual by voice identification speech processing.

Background Art

15 The concept of home incarceration has evolved as an alternative to detention in government jail and prison facilities. In cases of relatively light infractions, offenders, rather than being placed as inmates in overcrowded facilities, are confined to predetermined limited geographical areas including, for example, homes and workplaces. The burden on the prison system is relieved by enabling more space for criminals convicted of more serious crimes. Cost efficiency is also a significant factor as the expense of incarceration in such a facility is quite high. The degree of severity of punishment and the prospects of rehabilitation of the

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light offender are more appropriate to a home incarceration environment than in a prison provided for felons.

In a "house arrest" situation, the detainees, of course, are more likely to interact with the community. Public security is a socially sensitive issue and it is important that the activities of captives be monitored and supervised. The whereabouts and identity of individuals should be capable of being established at any time without the necessity of assignment of a law enforcement officer for constant surveillance on a one to one basis.

A prior art monitoring arrangement is shown in Fig. 1. A bracelet 20 is worn on the wrist or ankle of the detainee. A radio transmitter 22 broadcasts a coded signal which is received at a base 24. The base may be stationary or mobile. Verification of the received coded signal is performed at the base as indicated in block 26. Inasmuch as the signal has a limited range, reception of the signal at the base is indicative that the bracelet, and presumably the detainee, is within the defined area of confinement. The signal may be continuously or selectively generated.

The base is under the control of a processor through a telephone line 30. The processor may be part of a local area network including a file server 32 having data base information of all detainees in the system. At any time the system may call, via the telephone, the confinement site and ask for verification. Telephone calls may be made randomly or at scheduled intervals determined by the system. If the signal is to be continuous and the base senses an interruption in the signal, the system will initiate a call for verification.

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During a call, the detainee is requested to position the bracelet appropriately near the transmitter. The transmitter then picks up the code from the bracelet and transmits it back to the base.

5 If the transmitter is beyond the range of the base, or if the code is not verified, the base can initiate a call to the system processor to indicate that the detainee is not responding or has not been verified.

10 A similar prior art arrangement is disclosed in U.S. Patent No. 4,747,120. A bracelet capable of generating a coded signal is worn by the person to be monitored. A decoder, connected with a telephone, can decode the signal when the bracelet is appropriately positioned adjacent the decoder and the decoded signal
15 can be transmitted over the telephone network to the remote system.

The above described arrangements, intended for selective or continuous personnel monitoring, have inherent disadvantages. In the prior art embodiment of
20 Fig. 1, lengthy interruptions in signal transmission can be caused by various sources of interference. As a result, the base may give frequent false indications of nonverification, requiring human intervention. Where the coded signal is transmitted by the phone line,
25 rather than by radio transmission, continuous monitoring is impractical, as an on line connection must be continuously maintained for each person monitored.

A phone call by the system to the confinement site for purposes of verification will not be productive
30 during periods in which radio transmission is interrupted by interference. As a backup for such instances, monitoring personnel may attempt to identify the voice of the called party during the telephone conversation. The listener would be required either to

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know the confinee personally or be familiar with voice recordings of the individual to be verified. Such identification attempts likely would not be successful if the system serves a large number of detainees or if the speech of the called party is slurred by the influence of drug or alcohol abuse. Enforcement personnel frequently must be dispatched to the confinement sites to resolve the issue.

A further drawback of these systems is that the coded signal may be verified without complete assurance that the signal emanates from the location of confinement. In the case of radio transmission to the base, while the transmission range may be limited, the range may nevertheless extend beyond the bounds of confinement. In the case of telephone transmission, the system may be thwarted by placement of a decoder at a telephone, which is provided with call forward service, in an unauthorized area. A call placed by the system to the site of incarceration could be call forwarded to the unauthorized area and the code would be verified, falsely indicating that the detainee is identified and present at the appropriate location.

A further complication in these systems involves the physical structure of the bracelet. Bracelets must be constructed to resist tampering. The device must be affixed to the particular individual so that the identity of that person can be assured when receiving the signal transmission. The device is cumbersome in order to prevent easy removal. In addition, each bracelet must have a self-contained power supply sufficient for operation over an extended time period.

U.S. Patent No. 4,843,377 contemplates the use of a voiceprint as a means for remote identification of a prisoner. Audio spectral analysis is performed and

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A further object is to permit multiple legitimate sites of incarceration based, for example, on time of

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Once in the system database, and with the voice templates established, the inmate is subjected to periodic testing. Testing may be performed at predetermined schedules and at random intervals. A test is initiated by retrieving the inmate's number from the database and calling the incarceration site. An announcement is then made, requesting the inmate to call back in to the home incarceration center within a fixed time period to conduct the voice identification test. The system will be prepared to accept the incoming call. Caller line identification at the control center determines if the return call is made from the incarceration site. During the call, the inmate is required to recite a statement, prepared at the incarceration control center, including randomly chosen words from the template vocabulary. Comparison is made, using speech analysis, between the recited statement and the stored templates. As the statement is unknown to the inmate in advance, an attempt to use a voice recording as a response, with the inmate absent, would be futile.

The testing can be controlled manually at the incarceration center or be handled completely automatically. In an automated test procedure, the system would send notification, visibly or audibly, to an administrator of any test failures. Such notification may be transmitted through the network to the administrator at a location remote from the test center. A log file is maintained by the system for the purpose of recording all activity by the system, whether manually or automatically instituted.

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The system can operate in the environment on one or more sites of the law enforcement authority premises on a dedicated line basis. Alternatively, a single system can be shared on a network basis by several law enforcement agencies by appropriate partitioning. An additional aspect of the invention is call forwarding control by one center to another for "after hours" monitoring or for other purposes.

Additional objects and advantages of the present invention will become readily apparent to those skilled in this art from the following detailed description, wherein only the preferred embodiment of the invention is shown and described, simply by way of illustration of the best mode contemplated for carrying out the invention. As will be realized, the invention is capable of other and different embodiments, and its several details are capable of modifications in various obvious respects, all without departing from the invention. Accordingly, the drawings and description are to be regarded as illustrative in nature, and not as restrictive.

Brief Description of Drawings

Fig. 1 is a block diagram illustrating a prior art monitoring system.

Fig. 2 is a block diagram of a system according to the present invention, depicting a network including a control office and controller within the network.

Fig. 3 is a block diagram according to the present invention, representing broadly the components of the system including the control functions.

Fig. 4 is a function map of the home incarceration architecture of the present invention.

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Fig. 5 is a function map of the speaker verification process of the present invention.

Fig. 6 is a network layout of the present invention, illustrating transfer capability among various geographically separated control centers.

Best Mode for Carrying out the Invention

Fig. 2 broadly illustrates a home incarceration system including incarceration control center 48. An adjunct processor/server is shown at 50 interconnected through a network 52 to basic incarceration controllers 54, only one of which is represented in the figure for simplicity of illustration. Network 52 may be a local area network, such as ethernet, or a wide area network, such as a private line T1 network. The basic incarceration controller is shown connected, via telephone facilities (e.g., lines), to a central office 56, which is also connected via telephone lines to a particular local incarceration site 58. In addition to serving the area of central office 56, control center 48 may be extended to include additional central office areas such as the central office 60, shown connected therewith through interoffice facility line 62.

The basic incarceration controller includes telephone interfaces, a processor and voice processing/response capabilities, using appropriate hardware and software. The basic incarceration controller may also include storage for the inmate database and speech templates to perform all control functions as an independent unit. The system capacity can be extended beyond the limits of the basic incarceration controller by the adjunct processor/server, which includes memory storage and program control for the basic incarceration controller.

Fig. 3 is a further development of the control elements of the system shown in connection with central office 56. The central office is connected to subscriber loop connector 70 and modem 74 through bridge circuit 72. Bridge circuit 72 allows an incoming call to be split, permitting the incoming call signals to be applied to the subscriber loop connector 70 and modem 74. The subscriber loop connector is connected to a communications port, not shown, in controller 78 through amplifier/filter circuit 80. The modem 74 is connected to an originating call identification device 76.

The subscriber loop connector is a well known unit that performs both incoming and outgoing call functions. This unit serves to control the telephone connection with the central office and user telephone line. For incoming calls, for example, the unit detects ringing, on-hook and off-hook. The unit, under direction of the controller, performs outgoing call functions. These functions, in an alternative embodiment, can be incorporated into an appropriate function board in the system microprocessor.

In operation, for incoming calls block 76 identifies the originating telephone number from information transmitted between the first and second ringing signals. A detailed description of the preferred composition of this device is contained in U.S. application serial number 07/515,027, filed April 26, 1990 which application is herein incorporated by reference. Alternatively, the functions of block 76 can be incorporated in the control program.

The subscriber loop connector establishes off-hook connection between the central office and the controller after the second ring. At this time the calling line has been identified by block 76 and this information is

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transmitted to the controller 78. The controller includes a processor for comparing the caller identification information with the stored database information associated with the inmates.

5 The processor also performs speech analysis, comparing the transmitted voice of the caller with stored voice templates. Speech and voice processing may be performed in accordance with technology well known in the art. Examples of suitable speech verification
10 algorithms may be found in "Digital Processing of Speech Signals," by Rabiner and Schafer, Bell Laboratories, Prentice-Hall, Inc. 1978, particularly at page 457. Further description of voiceprint analysis for voice
15 identification may be found in U.S. patent number 3,525,811.

 The filters and amplifiers forming block 80 condition the transmitted audio signals to limit the band width and strengthen the signals appropriately to the requirements of the processing to be performed in
20 controller 78. Two way voice communication is transmitted between the incarceration site and the controller through the path including the central office, bridge circuit, subscriber loop connector, and
25 amplifier/filter circuit.

 Upon entering a new inmate into the system, a telephone call is established whereby "voice training" is performed. Voice templates of a selected word vocabulary are created and stored in the data base. The data base also includes the inmate's telephone number at
30 home, work or other permitted location, scheduled hours at each permitted location, telephone number of probation officer or other official to notified in case of a violation, and any other pertinent information.

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The data base can be updated at any time without interrupting the calling activity of the system.

Testing is performed by calling the telephone at which the inmate is scheduled to be and requiring the inmate to call back to the control center. In the return call, the caller line is identified by block 76 and the inmate is required to repeat a statement including selected words from the template vocabulary. Verification of the caller's voice is made by comparison therewith with the stored templates, using voice analysis techniques described above. Dynamic adaptive updating of the templates may be periodically performed upon successful voice verification.

Calls may be placed by the control center on the basis of a predetermined schedule as well as randomly. The system has flexibility to determine frequency of random calls made per day and to change the frequency for each inmate as deemed appropriate. For example, inmates who have violated curfew might be assigned a higher frequency of random calls. In addition, inmates may be required to call in regularly at predetermined times.

Violations are reported automatically to administrative personnel by transmission of a message to a remote printer or terminal. Notification may also be effected by audible alarm, paging or delivery of a voice mail message. All activity is recorded in a log file maintained in the system.

The home incarceration monitoring scheme may include a continuous signalling device worn by the inmate as part of a hybrid system. This added redundancy would make the home incarceration concept more socially acceptable as well as afford continuous surveillance. During times in which broadcast

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transmission of the continuous signal is interrupted by interference or other instances in which no signal is received, the system can initiate a call to the inmate for verification by calling line identification and voice analysis.

Figs. 4 and 5 are charts illustrating the functions of the system including initialization, database administration, training and testing. These functions are under the control of a main program executed by the system processor. Database administration includes adding and deleting information, as well as a print capability. In Fig. 5, speech processing includes voice training to create templates and testing, using the templates and transmitted speech.

Calling party number identification may be obtained through ISDN or analog lines equipped with caller line identification or similar services. Number identification can also be transmitted using out of band signaling, packet switching or Simplified Message Service Interface (SMSI), ISDN primary rate access and bulk calling line identification. In some cases a trunk arrangement may be used in a PBX environment.

Fig. 6 illustrates an intelligent network application of the home incarceration service. Central offices 56, each serving end user incarceration sites 58, are shown interconnected with each other. A local control center 54 may be customer premises equipment or network based and can perform voice verification and caller party number identification. Similarly, a larger area control center, which may be customer premises equipment or network based, is shown at 55.

Sufficient hardware and software to serve the entire system is provided at network base processor 50, which may be used in conjunction with signal control

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point 80. The signal control point is attached to the network through signal transfer point 82 to monitor all signaling within the network and to intelligently control the action to taken based on the signal. Additional signal transfer points may be included to accommodate network size.

The signal transfer point is connected to each of the central offices through SS7 or other data links for database information transfer. The local control center may be operational for limited hours. Transfer of the functions of this center for after hours coverage can be made to the area control center under control of the network base processor via the signal transfer point or by call forwarding from the local office.

Only the preferred embodiment of the invention and but a few examples of its versatility are shown and described in the present disclosure. It is to be understood that the invention is capable of use in various other combinations and environments and is capable of changes or modifications within the scope of the inventive concept as expressed herein.

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1. A method for remotely verifying, at a verification site, the attendance of a particular person at a predetermined area, said area being provided with a telephone, comprising the steps of:

determining a voice characteristic of said person at said verification site in response to speech transmission through said telephone connection; and

identifying a calling telephone line
directory number in response to an incoming
telephone call;

analyzing a voice transmitted during said incoming call.

2. A method as recited in claim 1, wherein said step of testing further comprises a step of determining whether the identified telephone line directory number corresponds to a predetermined line directory number associated with said telephone.

calling said telephone from said verification site;

5 establishing a further on line connection between
said verification site and said telephone;

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7. A method as recited in claim 6, wherein said step of determining a voice characteristic further comprises dynamically updating the stored templates.

8. A method as recited in claim 6, further including the step of generating a warning indication upon a condition that either said identified telephone line does not correspond to a line associated with said telephone or that the voice transmitted during said incoming call does not match said stored templates.

9. A method as recited in claim 8, wherein said generating step comprises displaying a message on a terminal.

10. A method as recited in claim 9, wherein said terminal is remote from said verification site.

11. A method as recited in claim 8, wherein said generating step comprises printing out a message.

12. A method as recited in claim 8, wherein said generating step comprises transmitting a warning message.

13. A method as recited in claim 12, wherein said message is a paging communication.

14. A method as recited in claim 12, wherein said message is a voice mail message.

15. A method as recited in claim 12, wherein said warning message comprises an audible alarm.

16. A method as recited in claim 12, wherein said step of transmitting a warning message comprises automatically generating a radio dispatch to a patrol vehicle.

[illegible]

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17. A method as recited in claim 6, further comprising storing results of the tests performed.

18. A system for monitoring at one or more remote locations the presence or absence of a particular person within a defined area comprising:

a telephone at said defined area;

5 verification means remote from said area for verifying the identity of an individual at said area; and

10 a communications network for establishing communication between said telephone and said verification means;

said verification means comprising:

voice processing means for analyzing an incoming voice transmission from said communications network; and

15 caller line directory number identification means for identifying an incoming caller telephone line.

19. A system as recited in claim 18, wherein said voice processing means comprises:

means for creating voice templates of a preselected word vocabulary for said person;

5 means for storing said voice templates; and

means for comparing spoken words of said voice transmission with said voice templates.

20. A system as recited in claim 18, wherein said verification means further comprises storage means for storing information including identification of said telephone line directory number as a reference for

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5 comparison with incoming caller line directory number identification whereby origination of an incoming call from said area may be verified.

21. A system as recited in claim 18, wherein said verification means further comprises means for generating a warning indication if said incoming² caller line directory number identification does not correspond to said stored telephone line directory number identification or if said spoken words of said voice transmission does not match the stored voice templates.

22. A system as recited in claim 21, wherein said means for generating includes a display terminal.

23. A system as recited in claim 21, wherein said means for generating includes a printer.

24. A system as recited in claim 20, including two or more telephones at geographically separated locations within said defined area, said storing means including stored identification of each of said telephones.

25. A system as recited in claim 18, including a plurality of said verification means connected to said communications network at separated locations, each of said verification means capable of monitoring a plurality of identified persons at various locations within a distinctly defined area.

26. A system as recited in claim 25, wherein said communications network comprises a plurality of signal transfer points and call forward means for transferring

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5 verification operation from one of said verification means to another of said verification means through a signal transfer point in said network.

27. A system as recited in claim 18, further including means affixed to said person for transmitting a continuous signal and means for monitoring said continuous signal.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1

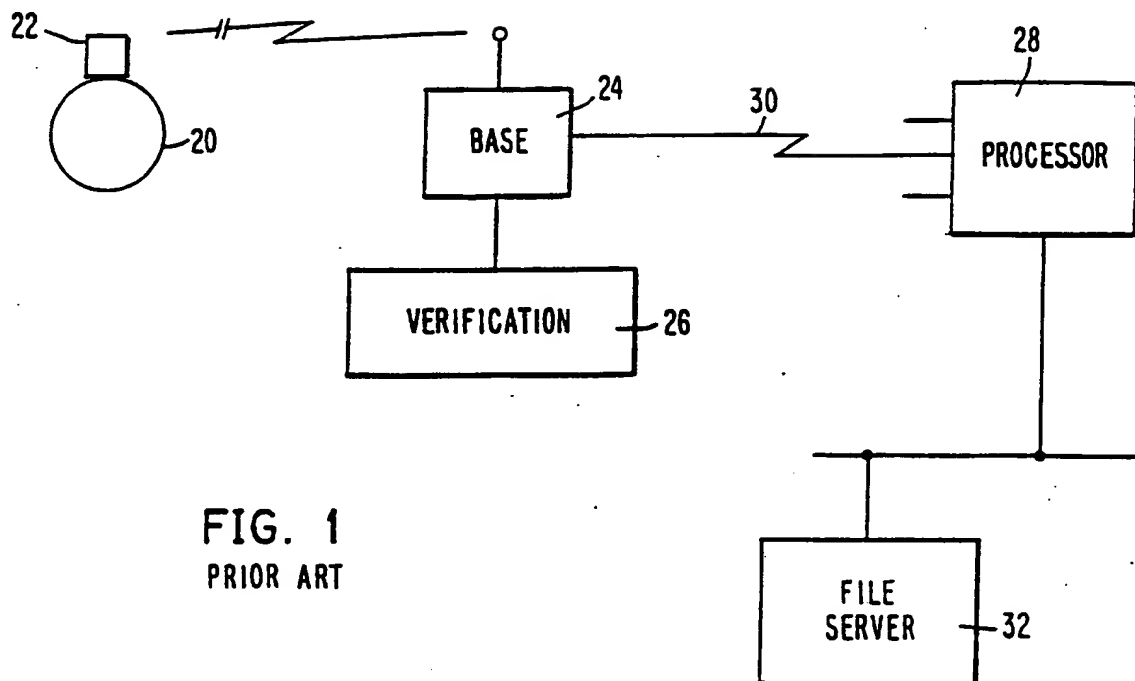


FIG. 1
PRIOR ART

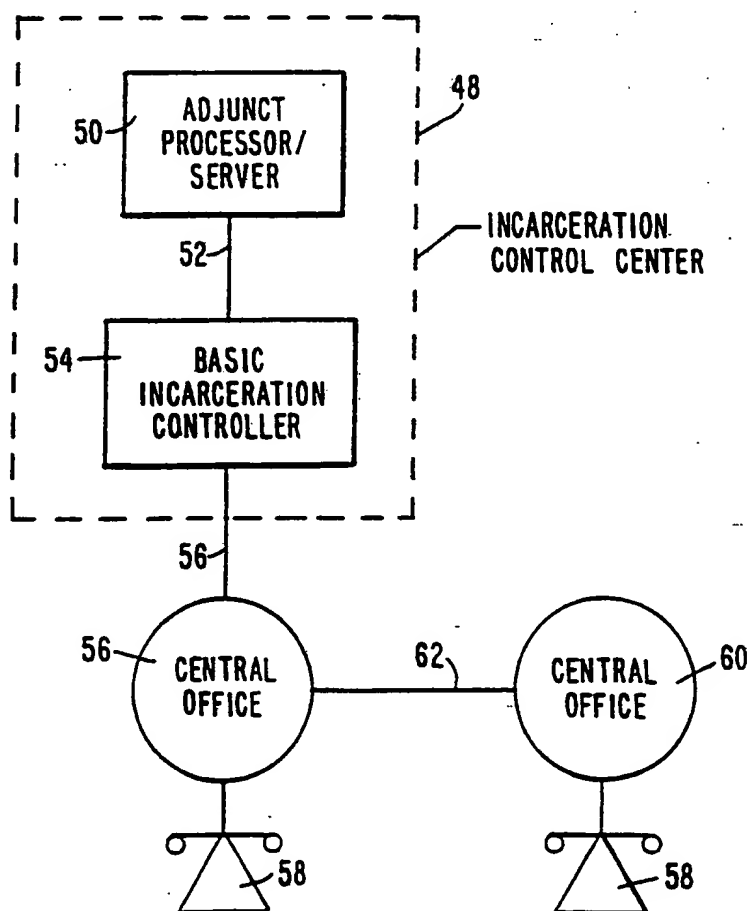


FIG. 2

11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1041 1042 1043 1044

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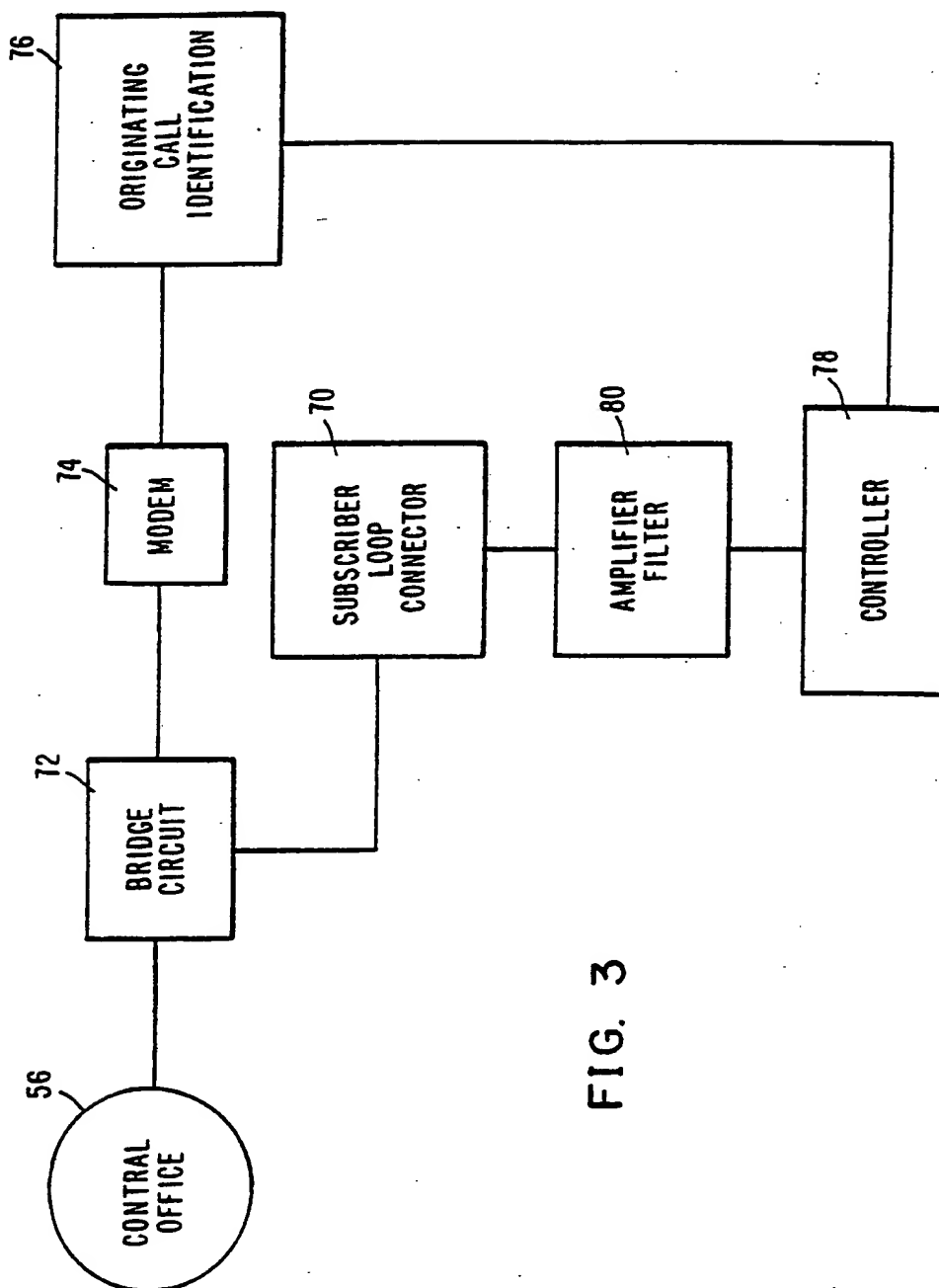


FIG. 3

FIG. 3 is a block diagram of a communication system.

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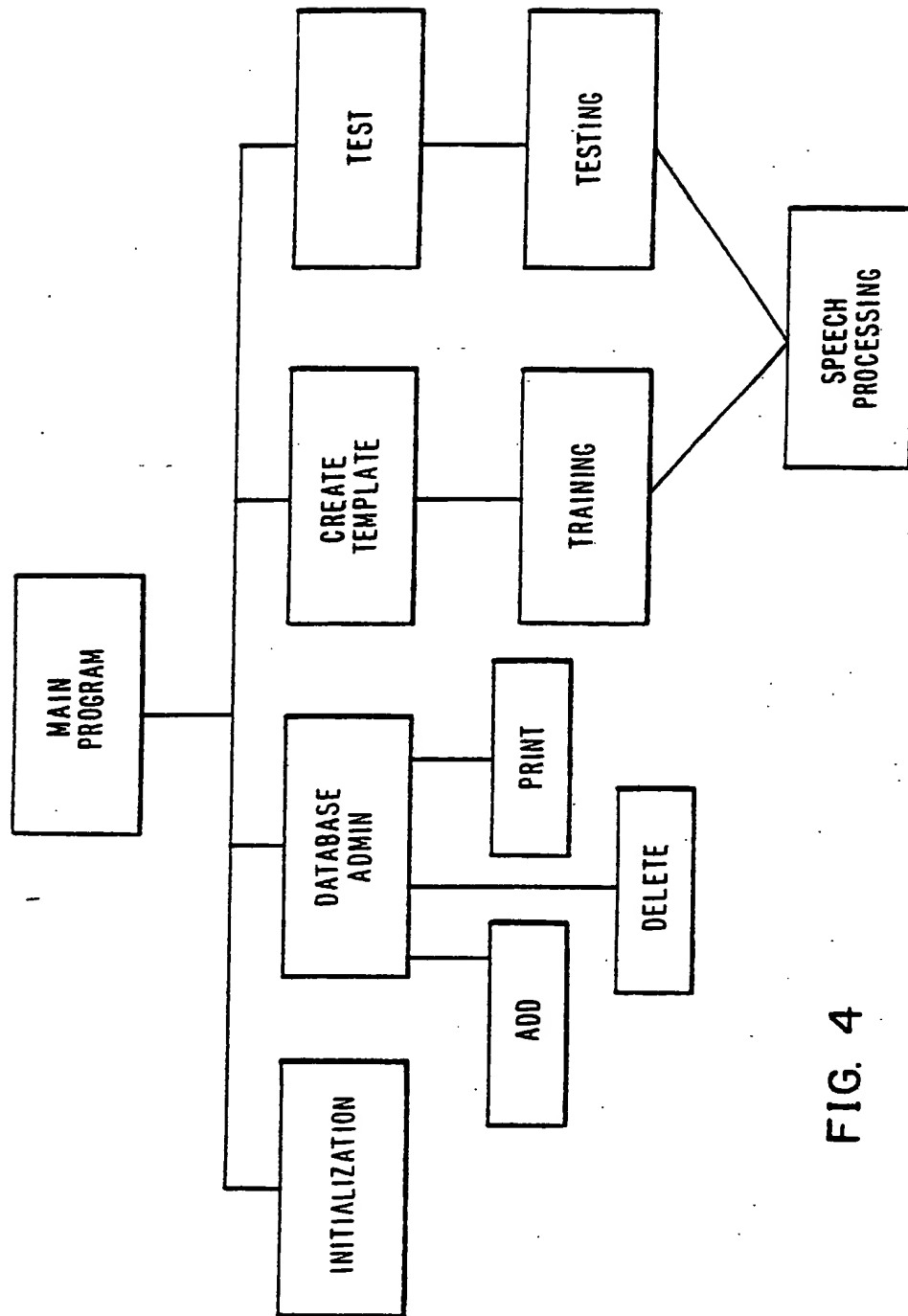


FIG. 4

FIG. 4

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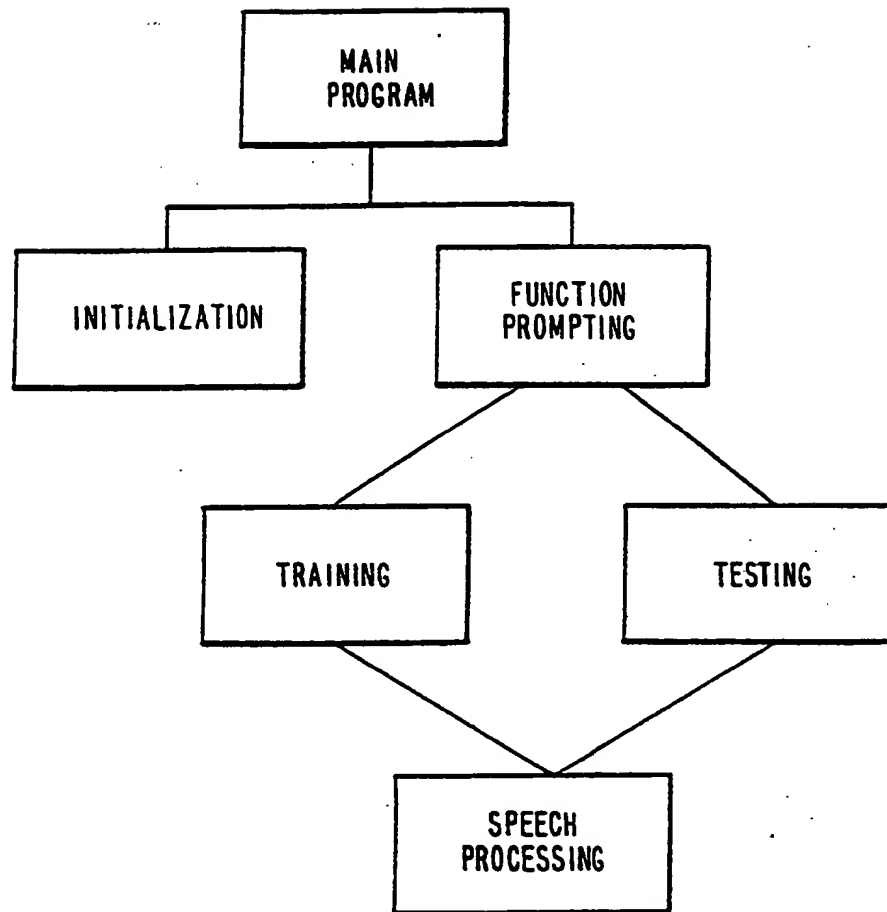


FIG. 5

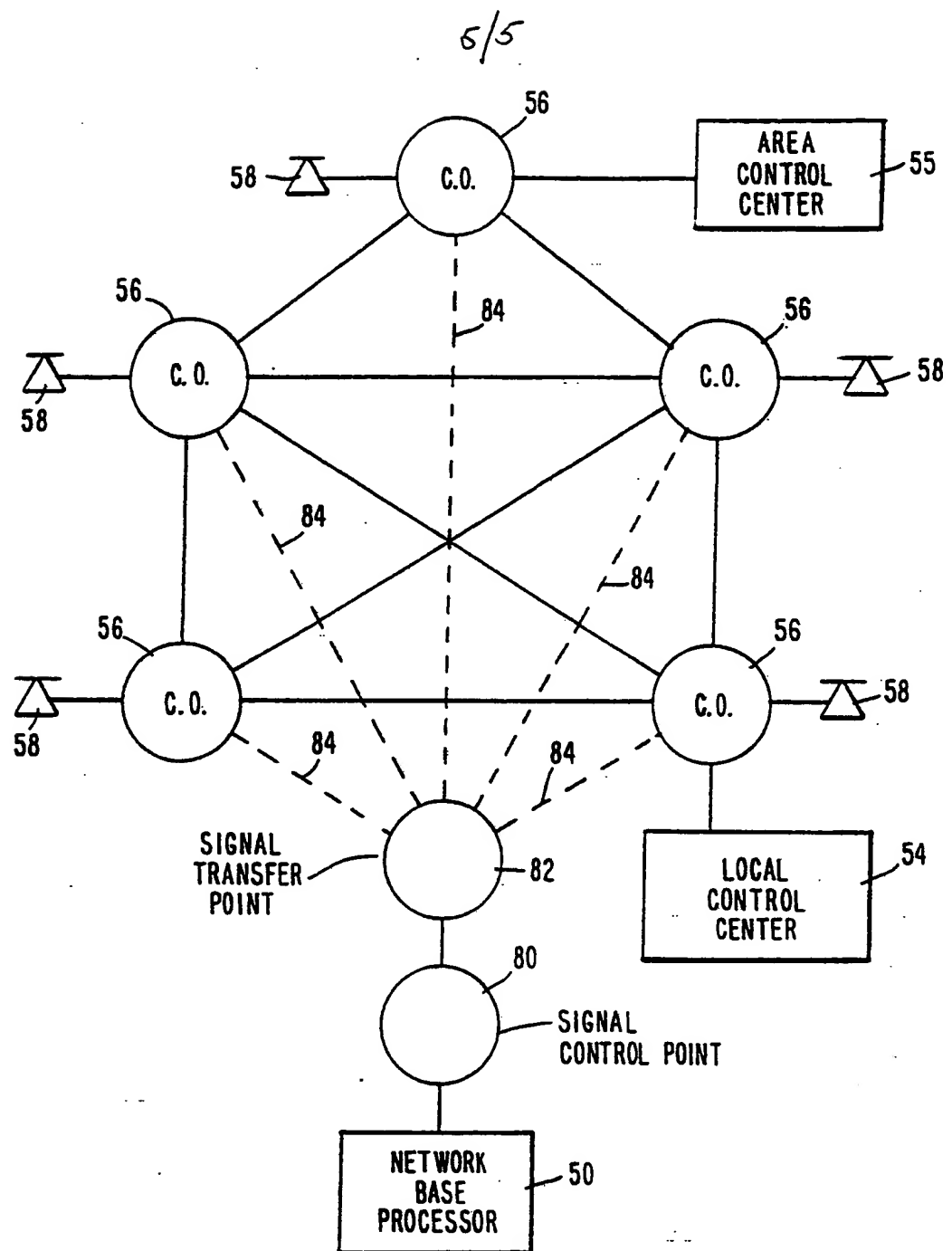


FIG. 6

INTERNATIONAL SEARCH REPORT

PCT/US92/07645

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :H04M 11/04

US CL :379/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 379/42,49,50,106,142;340/505,539,573,592,825.08,825.34,825.36;381/42;381/2-4

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

none

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A, 5,023,901 (SLOAN ET AL) 11 JUNE 1991 See entire document.	1-27
A,P	US,A, 5,054,055 (HANLE ET AL) 01 OCTOBER 1991 See entire document.	1-27

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:	T	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
A document defining the general state of the art which is not considered to be part of particular relevance	X*	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
E earlier document published on or after the international filing date	Y*	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	Z*	document member of the same patent family
O document referring to an oral disclosure, use, exhibition or other means		
P document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search

18 NOVEMBER 1992

Date of mailing of the international search report

14 DEC 1992

Name and mailing address of the ISA/
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